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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/811,415

03/26/2004

Liang Liu

2618

25859

7590

04/06/2006

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EXAMINER

RIELLEY, ELIZABETH A

ART UNIT

PAPER NUMBER

2879

DATE MAILED: 04/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/811,415

Applicant(s)

LIU ET AL.

Examiner

Elizabeth A. Rielley

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 17 January 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Response to Amendment*

Amendment filed 1/17/06 has been entered and considered by the Examiner. Currently, claims 1-16 are pending in the instant application.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3, 6, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al (US 6232706) in view of Yaniv et al (US 6312303).

In regard to claims 1 and 13, Dai et al ('706) teach a method for making a carbon nanotube-based field emission device (figure 1) comprising steps of: providing a insulating substrate having a surface (22; column 3 line 6 – column 4 line 42); depositing a catalyst layer on a selected area on the surface of the substrate (26); forming a carbon nanotube array extending from the selected area (28); and removing the substrate so as to expose the carbon nanotube array (column 4 lines 58-63). Dai et al ('706) are silent regarding the limitation of forming a metallic cathode electrode on the top of the carbon nanotube array. Yaniv et al ('303) teach forming a metallic cathode electrode (1103; figure 11; column 3 lines 41-46) on

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the top of the carbon nanotube array (1102) in order to produce an electric field for emission of electrons from the carbon nanotubes (column 3 lines 41-46). Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to combine the method of manufacturing a carbon nanotube device as taught by Dai with the electrode of Yaniv. Motivation to combine would be to produce an electric field for emission of electrons from the carbon nanotubes.

In regard to claims 3 and 15, Dai et al ('706) teach the substrate is made of heatproof glass, silicon, or silicon oxide (column 3 lines 6-18).

In regard to claim 6, Dai et al ('706) teach a thickness of the catalyst layer is in the range from 1 nanometer to 10 nanometers (column 3 lines 5-18 and 55-59).

Claims 4, 5, and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al (US 6232706) in view of Yaniv et al (US 6312303) and in further view of Hsu (US 20020042241).

Dai/Yaniv teach all the limitations set forth, as described above, except a thickness of the substrate is in the range from 1 micron to 1000 microns; the thickness of the substrate is in the range from 10 microns to 200 microns; and the substrate is removed by etching process. Hsu ('241) teach a thickness of the substrate is in the range from 1 micron to 1000 microns (paragraph 65); the thickness of the substrate is in the range from 10 microns to 200 microns (paragraph 65); and the substrate is removed by etching (paragraph 66) in order to create a more efficient device (paragraph 17). One skilled in the art would reasonably contemplate modifying the device of Dai/Yaniv to include the claimed thinness, as an obvious matter of design engineering as evidenced by Hsu. Applicant's claimed thickness does not provide unexpected results that are not within the teaching applied, since both the layer thickness

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disclosed by Hsu, Dai, and Yaniv and the layer disclosed by the Applicant perform the same function of supporting the stacked layers of the device. Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to combine the emitter of Dai/Yaniv with the substrate of Hsu in order to support the device.

Claims 2, 8-9, 11, 12, 14, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al (US 6232706) in view of Yaniv et al (US 6312303) and in further view of Mirkin et al (US 20030049381).

In regard to claims 2, 14, and 16, Dai/Yaniv teach all the limitations set forth, as described above, except a variation in flatness of the surface of the substrate is less than 1 micron and the surface is polished with great flatness. Mirkin et al teach carbon nanotube emitting device that has a variation in flatness of the surface of the substrate is less than 1 micron (paragraph 142) and the surface is polished with great flatness (paragraph 177) in order to prepare the substrate to better adhere to the layers provided upon it. Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to combine the emitter of Dai/Yaniv with the substrate of Mirkin. Motivation to combine would be to improve the adhering qualities of the substrate.

In regard to claim 8, Dai/Yaniv teach all the limitations set forth, as described above, except the substrate having a surface which has a variation in flatness less than 1 micron. Mirkin et al teach carbon nanotube emitting device that has a variation in flatness of the surface of the substrate is less than 1 micron (paragraph 142). One skilled in the art would reasonably contemplate modifying the device of Dai/Yaniv to include the claimed flatness, as an obvious matter of design engineering as evidenced by Mirkin. Applicant's claimed flatness does not provide unexpected results that are not within the teaching

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applied, since both the layer disclosed by Mirkin, Dai, and Yaniv and the layer disclosed by the Applicant perform the same function of supporting the stacked layers of the device. Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to combine the emitter of Dai/Yaniv with the substrate of Mirkin in order to support the device.

In regard to claim 9, Dai et al ('706) teach the carbon nanotube array is formed by a chemical vapor deposition process (column 3 line 65 to column 4 line10).

In regard to claim 11, Dai et al ('706) teach the substrate is made of heatproof glass, silicon, or silicon oxide (column 3 lines 6-18).

In regard to claim 12, Yaniv et al ('303) teach a gate electrode adjacent to the carbon nanotube array (column 3 lines 29-37) in order to in order to in order to produce an electric field for emission of electrons from the carbon nanotubes (column 3 lines 41-46). Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to combine the method of manufacturing a carbon nanotube device as taught by Dai with the electrode configuration of Yaniv. Motivation to combine would be to produce an electric field for emission of electrons from the carbon nanotubes.

Claim 10 rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al (US 6232706) in view of Yaniv et al (US 6312303) in further view of Mirkin et al (US 20030049381) and in further view of Smalley et al (US 6183714).

Dai/Yaniv/Mirkin teach all the limitations set forth, as described above, except the carbon nanotube array is treated by laser irradiation to clean the surface thereof. Smalley et al ('714) teach of a

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carbon nanotube array that is treated by laser irradiation to clean the surface thereof (column 14 lines 55-67). Hence, it would have been obvious at the time of the invention to one of ordinary skill in the art to modify the method of manufacturing a carbon nanotube array, as taught by Dai/Yaniv/Mirkin with the laser cleaning by Smalley. Motivation to combine would be to have a clean carbon nanotube.

### *Response to Arguments*

Applicant's arguments filed 1/17/06 have been fully considered but they are not persuasive.

In regard to Applicant's argument that the prior art of record fails to teach the removal of the substrate on which nanotubes were formed and nanotubes used as bundles in an FED, the Examiner respectfully disagrees. Dai et al ('706) teach removing the substrate on which nanotubes were formed on column 4 lines 58-63, the use of nanotube bundles in an FED on column 3 lines 4-28. Therefore, the prior art of record teaches all the limitations in the current application.

### *Conclusion*

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action

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is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

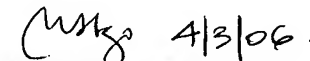
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elizabeth A. Rielley whose telephone number is 571-272-2117. The examiner can normally be reached on Monday - Friday 7:30 - 4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar Patel can be reached on 571-272-2457. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
Elizabeth Rielley

Examiner  
Art Unit 2879

  
MARICELI SANTIAGO  
PRIMARY EXAMINER